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# EXHAUST EMISSIONS FROM A VEHICLE EQUIPPED WITH THE ROBERTS INDUCTION MODIFICATION SUPPLIED UNDER CPA 70-51

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Ann Arbor, Michigan

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# Exhaust Emissions From a Vehicle Equipped With the Roberts Induction Modification Supplied Under Contract CPA 70-51

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National Air Pollution Control Administration
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15. Supplementary Notes

16. Abstracts

A 1970 Plymouth Duster, equipped with a 225 cu. in. six cylinder engine and automatic transmission was modified, with changes to the intake manifold, lean main jets in the carburetor and revised camshaft. The intake modification consisted of truncated cone inserts placed in each inlet port. The following standard emission tests were run: (1) standard 1970 Federal test procedure for exhaust emissions (FTP); (2) closed, constant volume sampling technique using 9 repeats of the 7-mode Federal emissions test cycle (CVS); (3) closed constant volume sampling technique using the LA4-S3 driving schedule as specified for 1972 and later. Performance tests were also conducted, consisting of wide open accelerations from 0-60 mph, 20-50 mph and 40-80 mph. The results indicate that the Roberts device: (1) caused no significant change in unburned hydrocarbons or carbon monoxide; (2) caused some (27%) reduction in oxides of nitrogen and (3) had a small detrimental effect on performance at high loads.

17. Key Words and Document Analysis. 17a. Descriptors

Air pollution
Automobiles
Exhaust emissions
Air pollution control equipment
Carbon dioxide
Tests
Carbon monoxide
Hydrocarbons
Nitrogen oxides
Performance tests
Sampling

17b. Identifiers/Open-Ended Terms

Roberts Induction Modification
1970 Federal Test Procedure (FTP)
Constant Volume Sampling Technique (CVS)
LA4-S3 Driving Schedule

17c. COSATI Field/Group 13B

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## Vehicle Tested

A 1970 Plymouth Duster equipped with a 225 cubic inch six cylinder engine and automatic transmission was modified under contract CPA 70-51. The modifications designed by Roberts consisted of changes to the intake manifold, lean main jets in the carburetor and revised camshaft. The intake modification consisted of truncated cone inserts placed in each inlet port.

## Tests Conducted

The vehicle was tested as received from the contractor and at two mileage increments. The vehicle was also tested with the inserts removed from the intake system. The following tests were run:

1. Standard 1970 Federal test procedure for exhaust emissions (FTP).

2. Closed, constant volume sampling technique using 9 repeats of the 7-mode Federal emissions test cycle (CVS).

3. Closed, constant volume sampling technique using the LA4-S3 driving schedule as specified for 1972 and later testing (LA4).

Closed cycle data were taken using a constant volume sampling technique. Bag samples from the CVS were analyzed using non-dispersive infrared analysis for carbon monoxide and the Whittaker "NOx Box" for determination of oxides of nitrogen, with hydrocarbons measured using a flame ionization detector. NDIR was used for continuous NOx measurements in the FTP tests.

In addition to the standard emission tests, performance data was obtained comparing this vehicle with a similar one from our NAPCA fleet. The tests consisted of wide open throttle accelerations from 0-60 mph, 20-50 mph and 40-80 mph.

## Emission Results

The emission results in table 1 compare the average emissions as received from the contractor and after removal of the intake manifold inserts. The data was taken using the 1972 Federal test procedure. Neither vehicle met the 1972 standards although hydrocarbons were lower after the device was removed.

In Table 2 comparisons between the as received vehicle and after device removal on the 1970 test procedure shows that the vehicle meets the standards after the device has been removed, although there is a increase in oxides of nitrogen. Table 3 reports all emission test results.

Performance Results

In Table 4 performance results are recorded showing very similar acceleration times for the 20-50 mph and the 0-60 mph tests but faster acceleration for the standard vehicle on the 50-80 mph acceleration.

Conclusions

1. The Roberts device caused no significant change in unburned hydrocarbons or carbon monoxide.

2. The Roberts device caused some (27%) reduction in oxides of nitrogen.

3. The Roberts device had a small detrimental effect on performance at high loads.

TABLE 1

1972 Emission Test Procedure

| | With Roberts Device | No Device |
|---|---|---|
| Hydrocarbons | 3.9 | 3.4 |
| Carbon Monoxide | 43 | 43 |
| Carbon Dioxide | 455 | 422 |
| Oxides of Nitrogen | 2.7 | 3.7 |

All values taken by constant volume sampler and reported in grams per mile. Standards for 1972 are hydrocarbons 3.4 gpm and carbon monoxide 39 gpm.

TABLE 2

1970 Emission Test Procedure

| | As Received | No Device |
|---|---|---|
| Hydrocarbons | 2.4 | 1.8 |
| Carbon Monoxide | 23 | 19 |
| Oxides of Nitrogen | 3.7 | 4.2 |

All values taken in accordance with the 1970 Federal procedure and reported in grams per mile. Standards for 1970 vehicles are hydrocarbons 2.2 gpm and carbon monoxide 23 gpm. NOx measured by NDIR and reported as NO2.

TABLE 3

| Mileage | Test | | HC | CO | CO2 | NOx |
|---|---|---|---|---|---|---|
| | With Roberts Device As Received, Test Summary | | | | | |
| 22198 | 9X7 | FTP | 2.85 | 24.51 | --- | 3.63 |
| | | CVS | 5.62 | 44.53 | 452 | 3.62 |
| 22206 | 9X7 | FTP | 2.17 | 20.96 | --- | 3.91 |
| | | CVS | 4.48 | 22.76 | --- | 3.73 |
| 22218 | LA4 | | 3.84 | 42.49 | 459 | 2.70 |
| 22226 | LA4 | | 3.95 | 44.43 | 451 | 2.69 |
| 22725 | 9X7 | FTP | 1.92 | 18.29 | --- | 3.71 |
| | | CVS | 3.52 | 30.6 | 398 | 4.31 |
| 22835 | LA4 | | 3.48 | 46.4 | 522 | 4.06 |
| 23101 | LA4 | | 12.47 | 51.0 | 501 | 3.67 |
| 23109 | 9X7 | FTP | 2.61 | 22.91 | --- | 4.07 |
| | | CVS | 4.73 | 45.3 | 437 | 5.0 |

All results reported in grams per mile

| | | | | | | |
|---|---|---|---|---|---|---|
| | Device Removed, Test Summary | | | | | |
| 23151 | 9X7 | FTP | 1.76 | 18.93 | --- | 4.21 |
| 23160 | LA4 | | 3.46 | 37.66 | 427 | 3.22 |
| 23142 | LA4 | | 3.39 | 48.86 | 418 | 4.32 |

All results reported in grams per mile. Vehicle equipped with lean jets and modified comshaft.

9X7 indicates that the CVS and FTP tests were run concurrently.

TABLE 4

Performance Test Results

| | Roberts Vehicle | Standard Vehicle |
|---|---|---|
| 20-50 mph | 8.3 sec. | 8.4 sec. |
| 0-60 mph | 14.6 sec. | 14.5 sec. |
| 50-80 mph | 17.6 sec. | 16.4 sec. |